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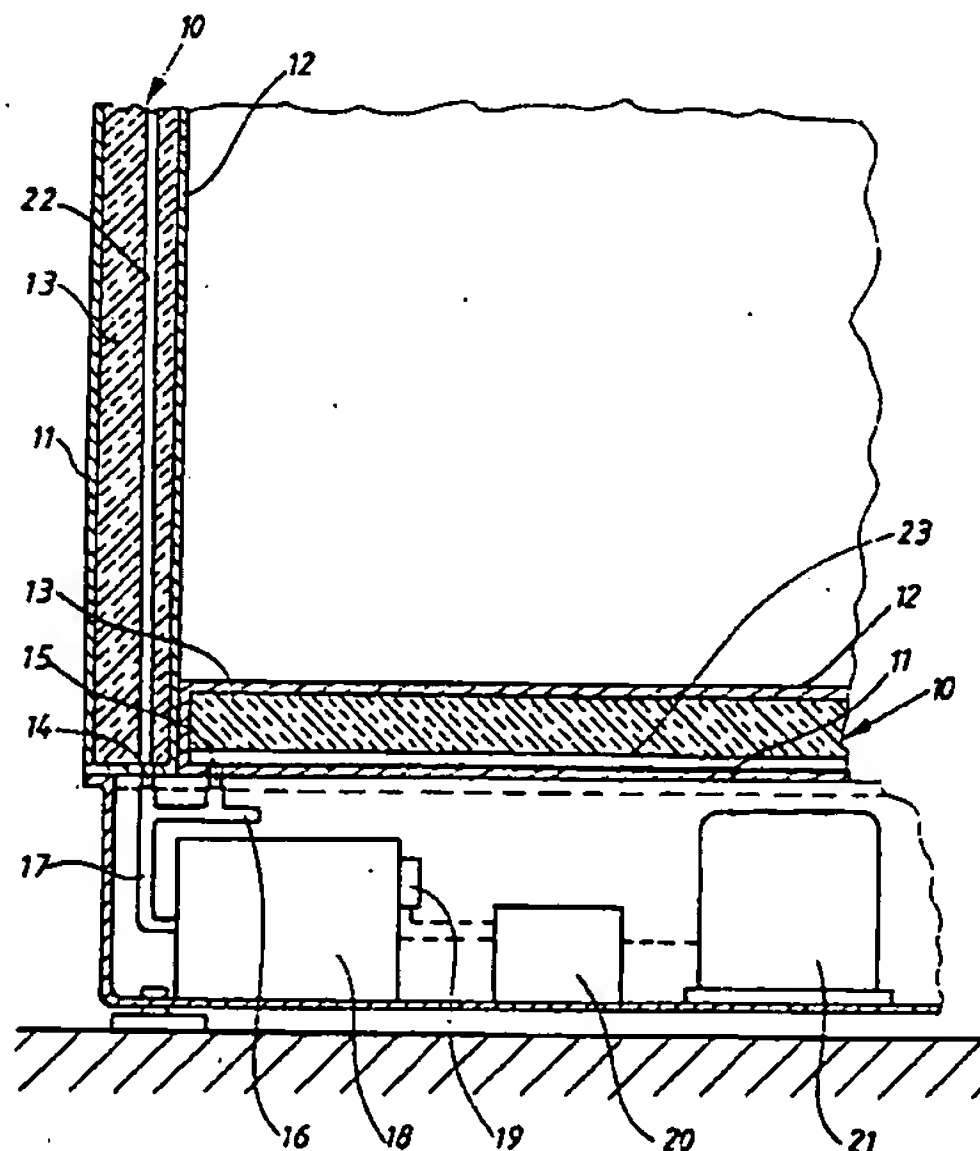
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54 **Insulation for refrigerators or freezers.**

57 This invention relates to a heat insulation for a refrigerator or freezer. The insulation comprises a material, which is placed in a hermetically closed space (13) surrounded by a diffusion tight shell, and which does not achieve its full insulating properties until the refrigerator has been used for a long time.



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This invention relates to an insulation for refrigerators or freezers.

Previously several different materials and material combinations have been suggested in order to increase the heat insulating characteristics for walls and doors in refrigerators and freezers as well as it has been suggested to use so called vacuum panels. Conventional insulations usually comprise foamed polymeric materials whereas for vacuum panels an evacuated shell of diffusion tight material - for instance plastic or sheet metal - which is filled with powder or cellular material is used. This last mentioned arrangement is described for instance in SE 90937, EP 188806, JP 63135694, US 5066437. The arrangement has however certain drawbacks since it is difficult to maintain sufficiently low pressures during the complete life time, which is 15-20 years, of the cabinet since also a minor leakage decreases the heat insulating characteristics. Further it is difficult and expensive to carry on the evacuation process as far as should be desirable in massproduction since such an evacuation process takes a very long time. Thus, because of the long and narrow evacuation passages it takes at least 15 hours to reduce the pressure to 1 mbar independently of the capacity of the vacuum pump whereas the production time for a refrigerator is abt 20 min. In order to make it possible to evacuate slightly faster, as appears from some of the above-mentioned publications, polymeric materials with open cell structure have been used.

The disadvantage with an open cell structure both with regard to conventional insulations and vacuuminsulations is however that it with such a structure is difficult to fulfil the demands for mechanical strength at lower densities. In practice it has been necessary to use comparatively high densities which means that the heat conductivity in the solid state increases considerably as well as price and weight.

A closed cell structure in combination with adherence to the surrounding shell gives mechanical stability also at comparatively low densities but demands for small cells in order to minimize the heat transportation by radiation and in order to get superinsulation (which means that the free length of movement of the molecules should be of the same magnitude as the size of the cell) at as high pressures as possible.

The above mentioned desires regarding closed and open cells are thus contradictory which means that the properties which have been regarded as most important, i.e. mechanical strength or the possibility to evacuate the insulation quickly, have determined what kind of cell structure that should be used.

It is also known, see US 4448041, to use vacuuminsulated wall elements for large mobile cold storage rooms the wall elements communicating with a vacuum pump. These vacuum pumps are however of conventional type and hence comparatively power demanding and expensive and their use can with re-

gard to costs and energy consumption only be motivated at the type of large construction which is described in the abovementioned publications.

Further FR 2628179 describes hermetically sealed wall elements which in a manner not shown in detail are connected to some kind of vacuum source the pressure of 50-100 mbar which is created being comparatively high and being in such an interval that it can not in any higher degree contribute to increase the heat insulation capability.

The purpose of this invention is to achieve an arrangement by means of which it should be possible to create a permanent vacuuminsulation with very good heat insulating characteristics for refrigerators and freezers in up-to-date massproduction and which in principle reduces the energy consumption with 50% compared to the refrigerators and freezers of today the arrangement not having the drawbacks which are described above with reference to the vacuum panels described. The basis of the invention is that the cabinet during the production is equipped with a cheap and energy saving vacuum pump which communicates with hermetically sealed spaces in the walls and/or doors of the cabinet these spaces being provided with a heat insulating material with particular properties these properties appearing from the characteristic part of the following claims.

An embodiment of the invention will now be described in detail with reference to the accompanying drawing in which the figure schematically shows a section through a refrigerator or freezer with an insulation according to the invention.

In the figure several wall parts 10 which surround a cold room are shown the wall parts having an outer and an inner shell 11 and 12 resp. which are joint to each other and which therebetween form an hermetically sealed space 13 which is filled with heat insulating material. This material at least partly consists of closed cells which are produced by foaming for instance polyol/isocyanate with a gas having such properties that it can diffuse through the cell structure with a velocity which is at least five times faster than the air gases. A suitable gas is for instance carbon dioxide. By foaming with small molecules, type carbon dioxide, a closed cell structure can achieve such a high diffusion velocity that the evacuation is possible during a reasonable time period such a period in this context being a 24-hour period up to some months. The evacuation process goes very far which means that a final pressure which is less than 0,1 mbar is maintained in the evacuation conduit 17 this level being achieved in the insulation not before a long time use of the cabinet 18. Each space 13 via an evacuation channel 14, 15, 16 communicates with an evacuation conduit 17 which is connected to a vacuum pump 18.

The vacuum pump is driven by an electric motor having a very low power consumption. The pressure

in the evacuation conduit 17 is sensed by a sensor 19 which is connected to an electric control means 20 deactivating the pump when a certain underatmospheric pressure has been achieved in the evacuation conduit. The control means 20 can also be used to activate or deactivate the compressor 21 in the cabinet from the thermostat.

In the material which is provided in the space 13 it is possible to make distribution channels 22 which connect remote parts of the insulation with the evacuation channels 14, 15, 16 the distribution channels being produced by means of plastic pipes, by thermal shock for instance by putting a thin unisolated conduit in the material after which a current is allowed to flow through the conduit so that the heat burns a channel or by using focused light for the same purpose. It is also possible to create distribution channels by putting a fibre material 23 in the insulation preferably on its outside. By a suitable choice of material also a spontaneous cracking of the cells can be achieved during the evacuation because of the pressure difference between the outside and inside of the cell.

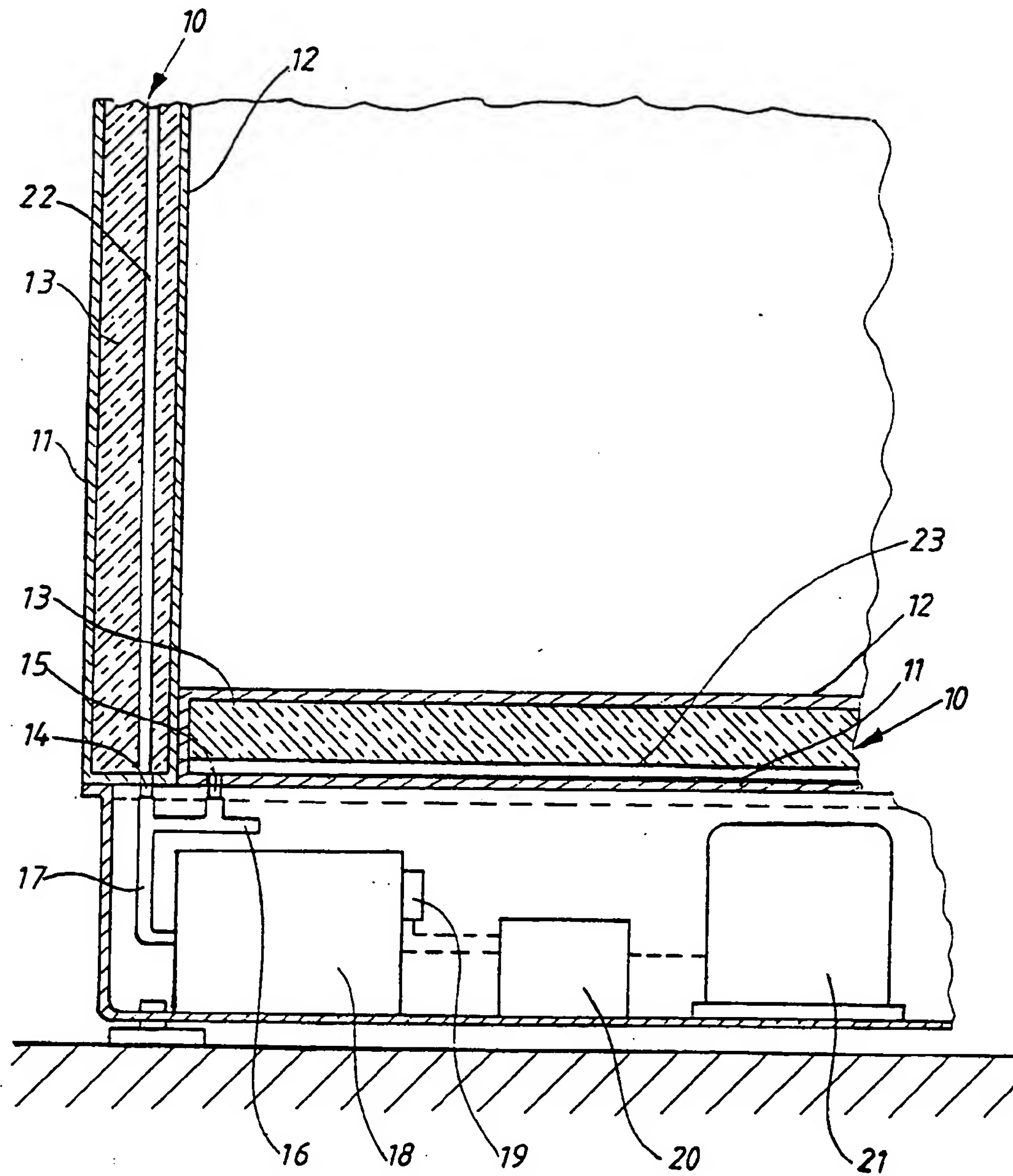
It should be mentioned that it is possible to place the insulating material free in any diffusion tight material for instance plastic the diffusion tight material forming a surrounding cover which after evacuation is placed in the shell which forms the walls of the refrigerator or freezer. This creates mechanical stability and also a slot between the shell and the insulating material the slot being used for the evacuation.

ution channels (22,23) for forming transport conduits for the gas in the insulation.

- 5 6. Insulation according to claim 5, **characterized In** that a fibre material is used as distribution channels (23) this material preferably being placed in touch with the shell.
- 10 7. Insulation according to claim 5, **characterized In** that the distribution channels (22) are created by means of thermal shock for instance by an electric conduit which is heated or by focused light.
- 15 8. Insulation according to claim 5, **characterized In** that the channels are formed in the boarder line between the material and the shell by not allowing the material to adhere to the shell.
- 20 9. Insulation according to any of claims 2-8, **characterized In** that the shell is a plastic material.

## Claims

1. Heat insulation for refrigerator or freezer, **characterized In** that it comprises a material, which is placed in a hermetically sealed space (13) surrounded by a diffusion tight shell, and which does not achieve its full insulating properties until the refrigerator has been used for a long time.
2. Insulation according to claim 1, **characterized in** that the space (13) communicates with a vacuum source (18) and that the material comprises closed cells with a gas which can diffuse through the cell structure with a velocity which is at least five times faster than the air gases.
3. Insulation according to claim 2, **characterized In** that the material consists of a foamed material such as polyol/isocyanate said gas being a drive gas in the foaming procedure.
4. Insulation according to claim 2 or 3, **characterized In** that said gas is carbon dioxide.
5. Insulation according to any of the preceding claims, **characterized In** that it comprises distrib-





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# EUROPEAN SEARCH REPORT

Application Number  
EP 93 85 0169

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
X A	US-A-1 898 977 (COMSTOCK) * page 3, line 19 - page 10, line 71; figures 1-11 *	1 2	F25D23/06
A	US-A-5 034 424 (WENNING) * column 19, line 8 - line 20 *	2-4	
A	US-A-5 009 952 (KLEPSCH) * the whole document *	3,4,9	
A	GB-A-760 942 (GENERAL ELECTRIC) * page 4, line 17 - line 38; figure 4 *	5,6,8	
A	FR-A-2 126 126 (ÉTABLISSEMENTS BONNET) * page 3, line 9 - page 6, line 26; figures 1-5 *	5,7,8	
A	GB-A-730 146 (GENERAL ELECTRIC) * page 2, line 7 - page 3, line 62; figures 1-3 *	5,8	
A	GB-A-865 391 (ROLLS-ROYCE)		TECHNICAL FIELDS SEARCHED (Int.Cl.5)
A	EP-A-0 476 337 (BASF)		F25D
A	US-A-1 550 961 (HAWKINS)		
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 21 January 1994	Examiner Boets, A
<p><b>CATEGORY OF CITED DOCUMENTS</b></p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons A : member of the same patent family, corresponding document</p>			

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